



**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación



Climate predictions for vineyard management

A.Soret¹, N.Gonzalez¹, V.Torralba¹, N.Cortesi¹, M. Turco, F. J.Doblas-Reyes^{1, 2}

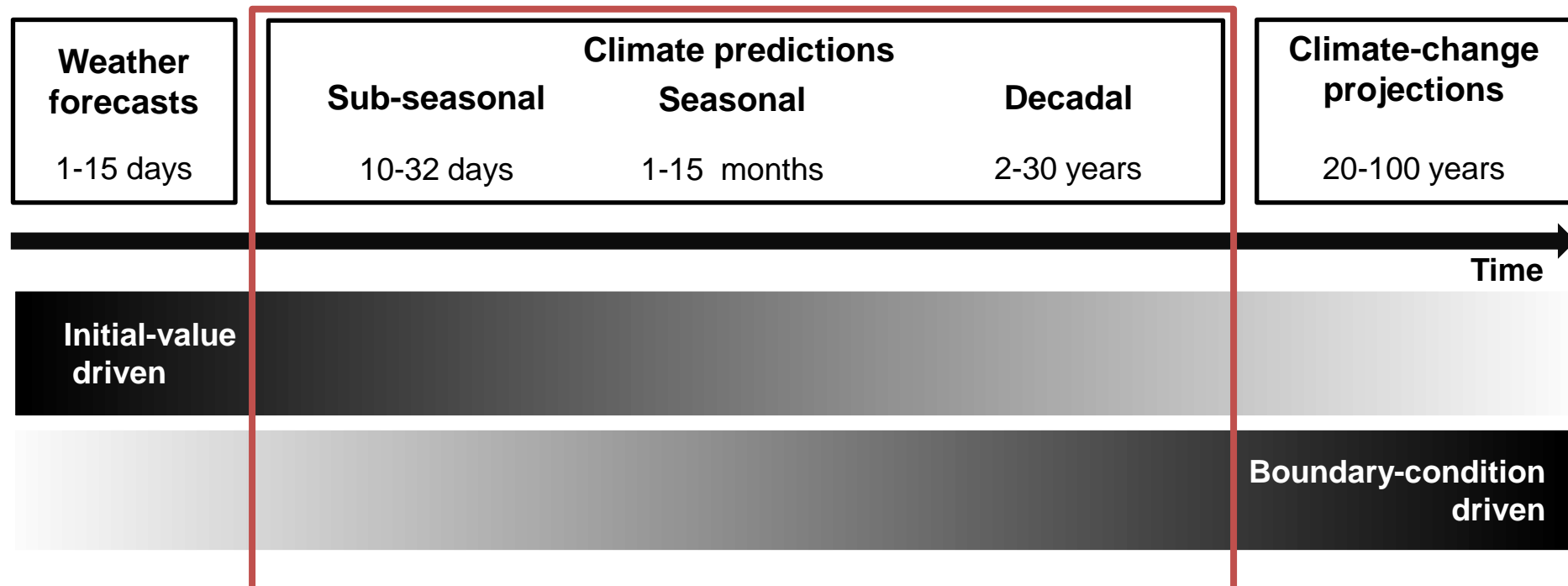
¹Barcelona Supercomputing Center, Barcelona (BSC), Spain

²Institució Catalana de Recerca i Estudis Avançats (ICREA), Spain



1. **Introduction to climate predictions** and their application in key sectors of society.
2. **Predictability** of seasonal forecast simulations.
3. **On-going development** at BSC exploring the applicability of seasonal predictions to agriculture and viticulture.
4. **Potential applications** of climate predictions for vineyard management.
5. **Preliminary results.**
6. **Conclusions**

- Weather forecasting: Initial-value problems
- Climate projections: forced boundary condition problem.
- **Climate predictions** (sub-seasonal, seasonal and decadal) in the middle.



- Viticulture sector routinely uses weather forecast up to 15 days. Beyond this time horizon, climatological data are used.
- In other sectors, climate information on seasonal-to-interannual time scales have already been illustrated for management decisions.



How can we predict climate for the coming season if we cannot predict the weather next week?

Weather forecasts

The forecasts are based in the initial conditions of the **atmosphere**, which is highly variable and develops a chaotic behaviour after a few days

Climate predictions

The predictions are based in the initial conditions of the **sea surface temperature, snow cover or sea ice**, which have a slow evolution that can range from few months to years.

ENSO is the most important source of predictability at seasonal timescales (see e.g. Doblas-Reyes et al. 2013)

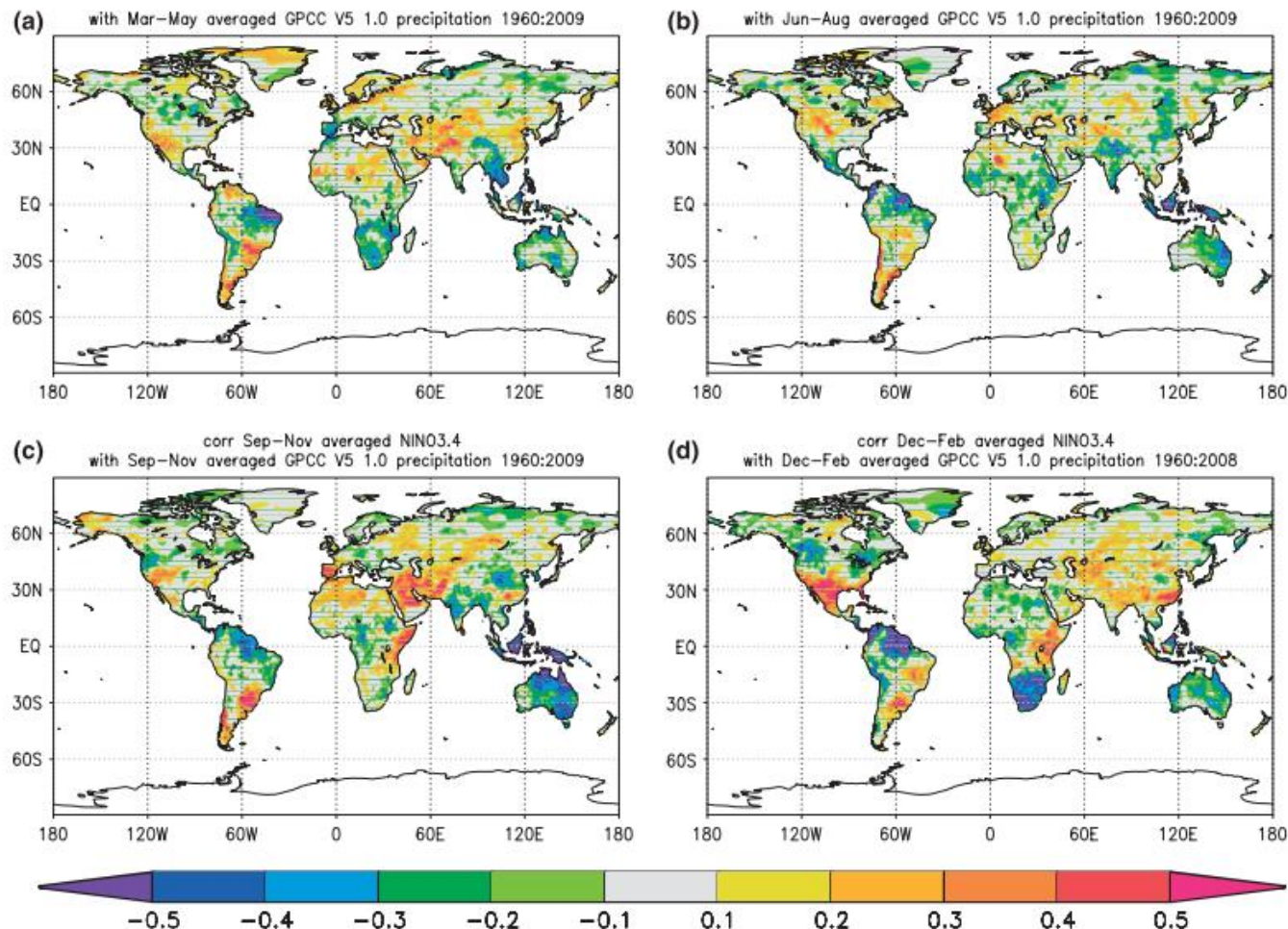
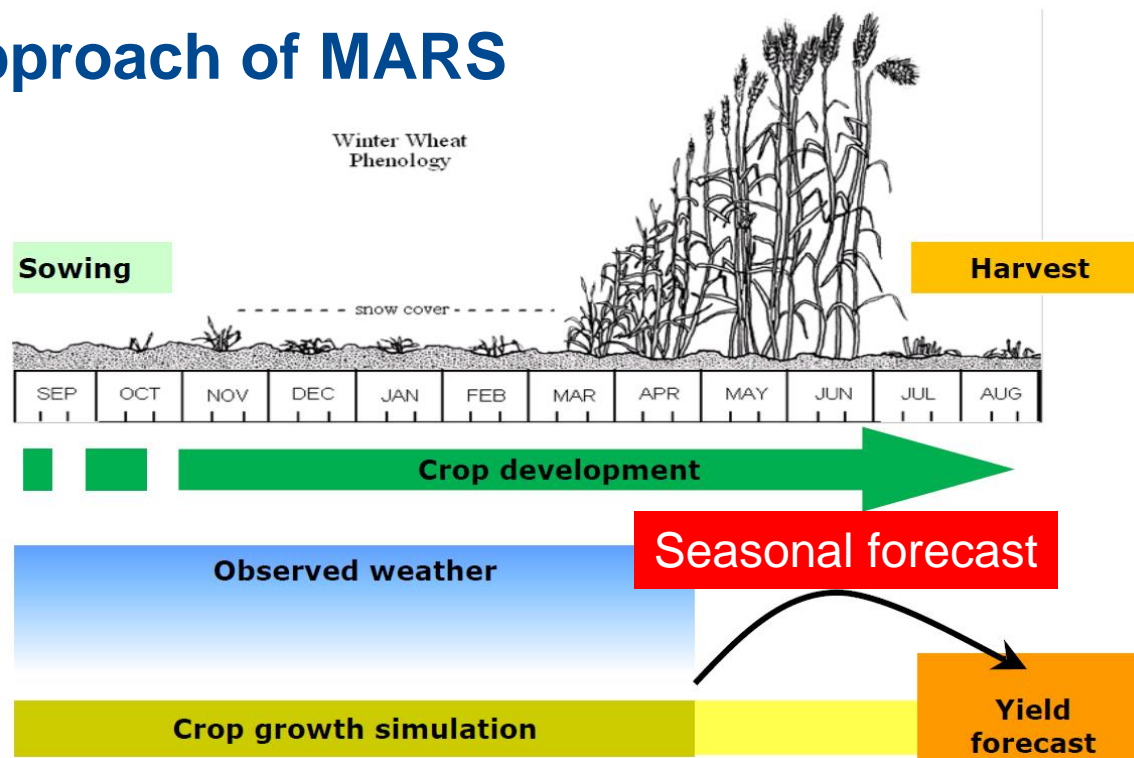


FIGURE 1 | Correlation between the ERSST³⁸ SST Niño 3.4 index (average temperature over 5°N–5°S, 170°–120°W) and the GPCCv5³⁹ gridded precipitation over the period 1960–2009. (a) March to May, (b) June to August, (c) September to November, and (d) December to February.

Testing seasonal forecast for MARS: BSC and JRC are exploring how the MARS Crop Yield Forecasting System (MCYFS) could ingest the seasonal forecast for a future operational use.

Current approach of MARS



Source: Toreti, 2015.
EUPORIAS

Seasonal forecast for viticulture: on-going activities



Barcelona
Supercomputing
Center

Centro Nacional de Supercomputación



SECTEUR PROJECT (negotiation process).



HIATUS (accepted).

Objective: develop a climate service for the wine sector to bridge this communications gap and to ensure that research reaches the industry and society in a timely and usable manner.

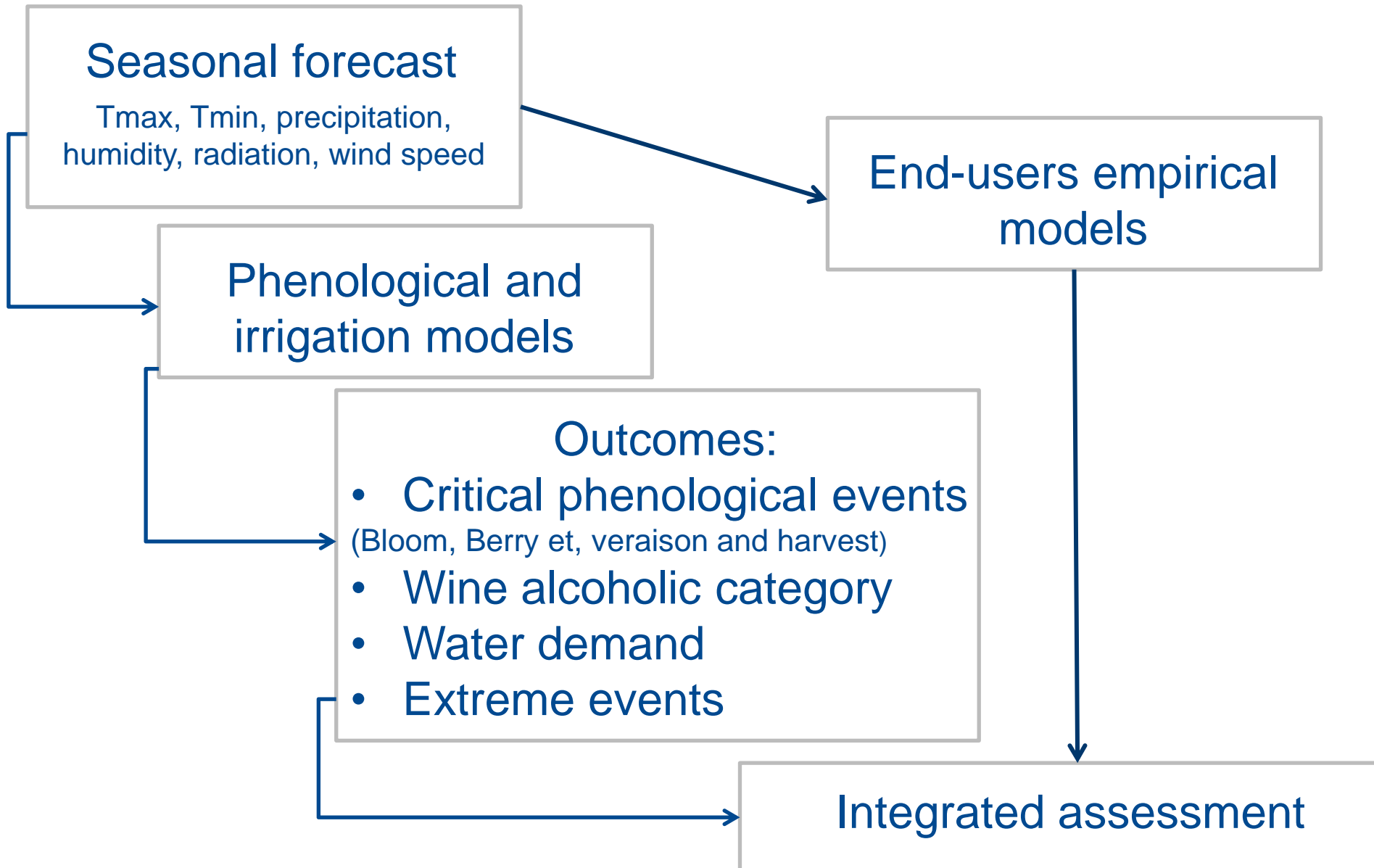
Seasonal forecast applications for vineyard management



PROCESS		days	months	years
		(1 - 30)	(1 - 12)	(1 - 50)
		Short-term	Medium-term	Long-term
PLANTING VINEYARD				
Siting				
Choice of scion variety				
Choice of rootstock				
Assessment of water needs				
Choice of trellis				
GROWING GRAPES				
Growth cycle duration				
Pathogen pressure				
Abiotic stresses				
Productivity				
Quality				
Identity				
MAKING WINE				
Wine style				
Harvest date and duration				
Building design				
Energy consumption				
Emissions				
LOGISTICS				
Destination constraints				
Choice of itinerary and transportation				
Fuel and energy consumption				
Emissions				
DRINKING WINE				
Style suitability				
Trends and fads				
Seasonality				

Source: Antonio Graça,
SOGRAPE VINHOS
SA, 2014

Seasonal forecast applications for vineyard management: model chain



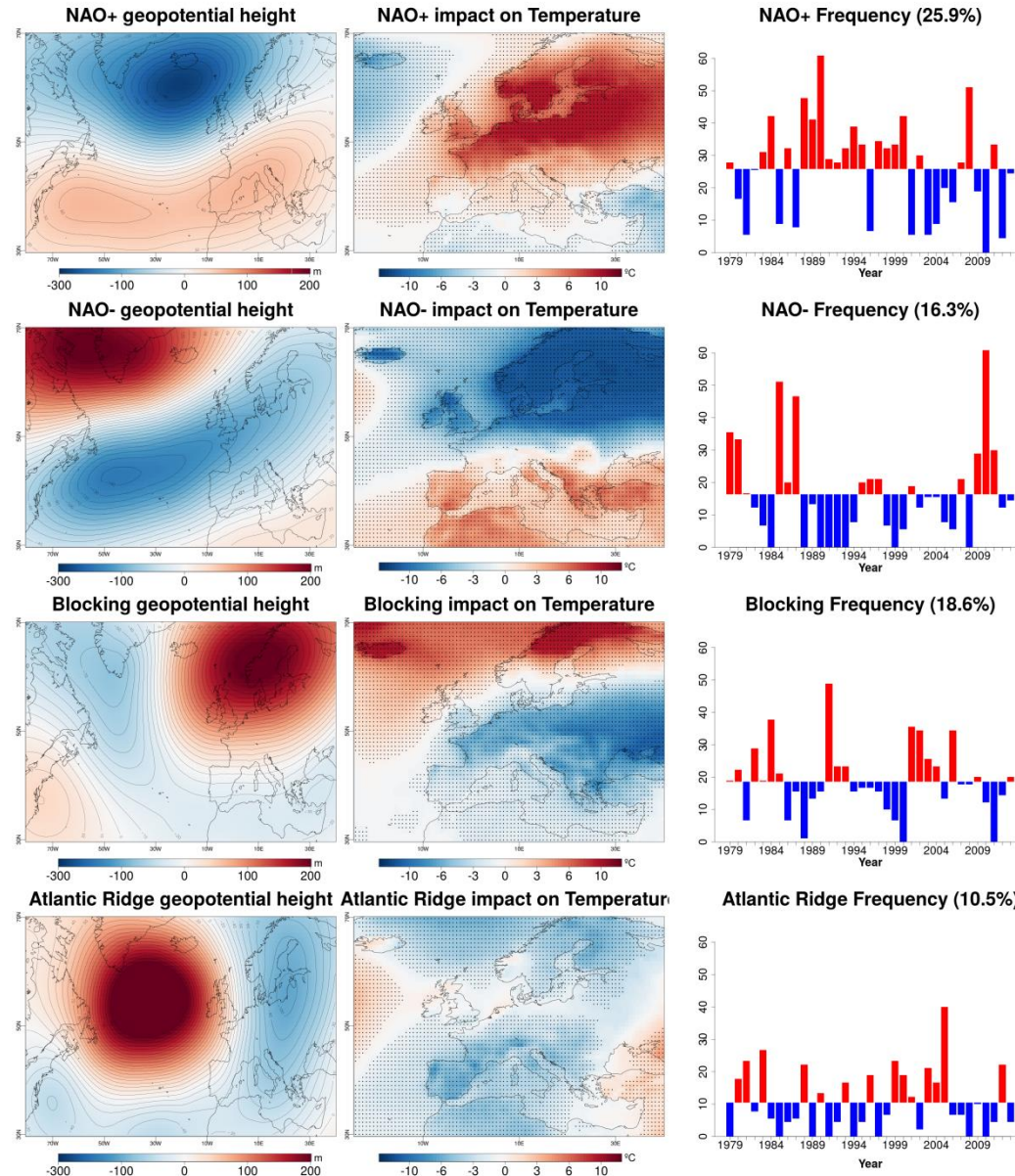
Preliminary results: Weather regimes. Winter



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación

EXCELENCIA
SEVERO
OCHOA

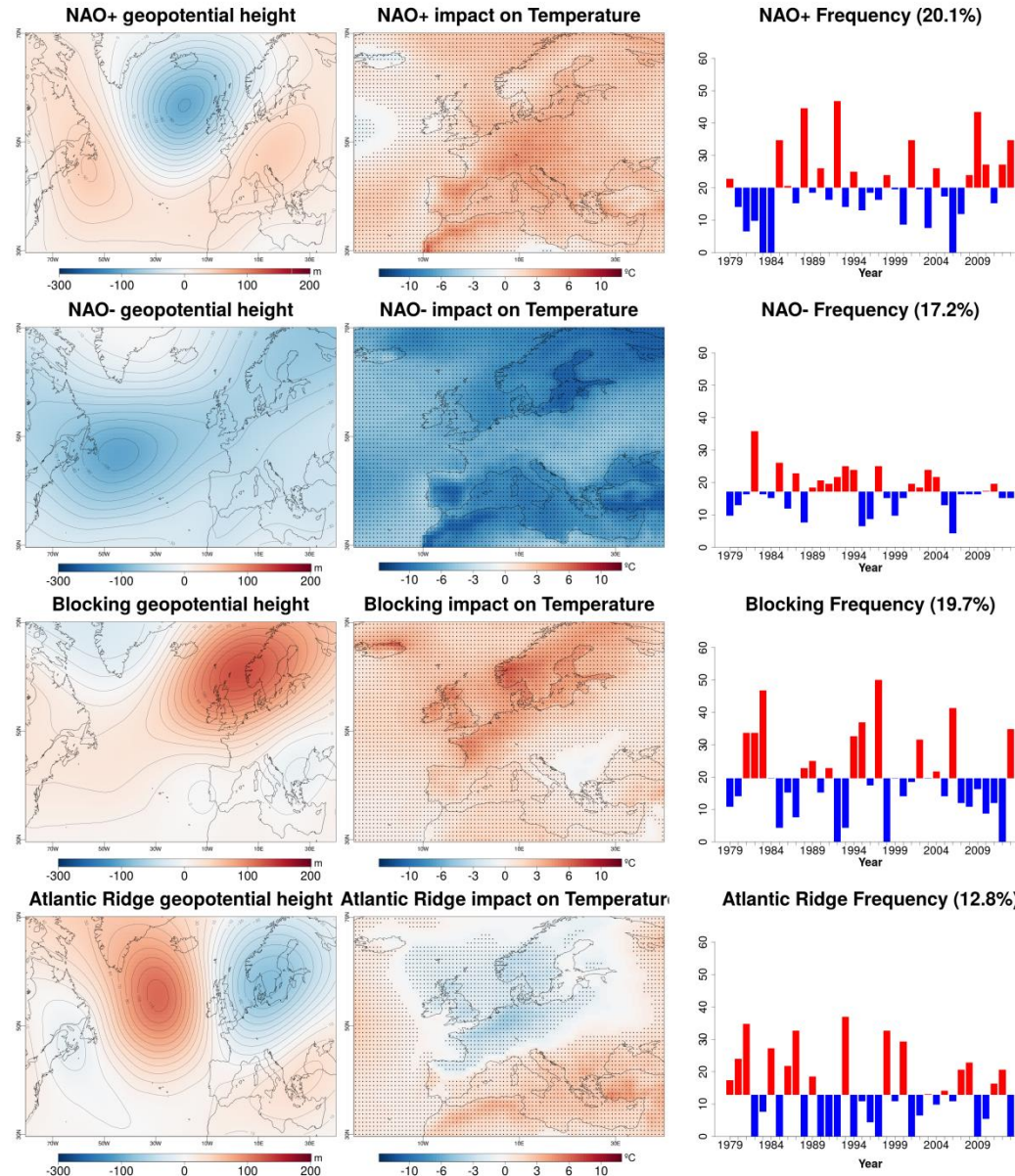
Weather Regimes for Winter season (1979-2013). Source: ERA-Interim



Preliminary results: Weather regimes. Summer



Weather Regimes for Summer season (1979-2013). Source: ERA-Interim



Preliminary results: Skill of seasonal temperature forecasts



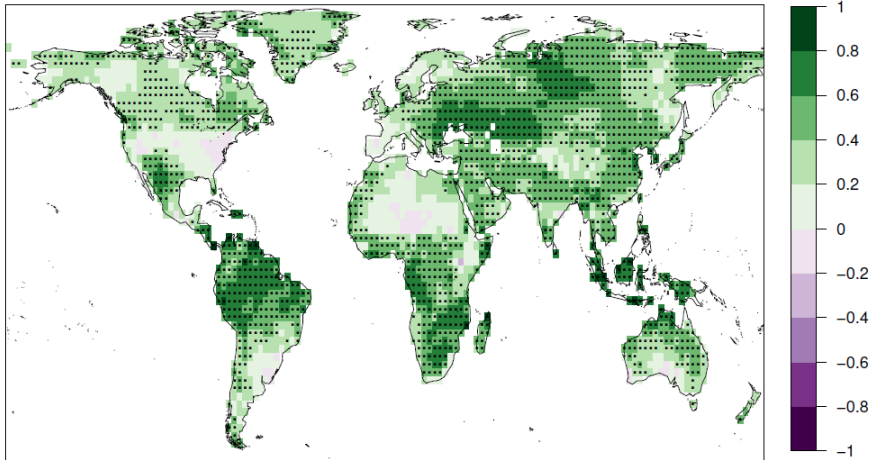
Barcelona
Supercomputing
Center
Centro Nacional de Supercomputación



Spearman correlation for T2M ECMWF–System4 against ERA–Interim

Start date: February – Lead time: 1 – Period: 1982/2014

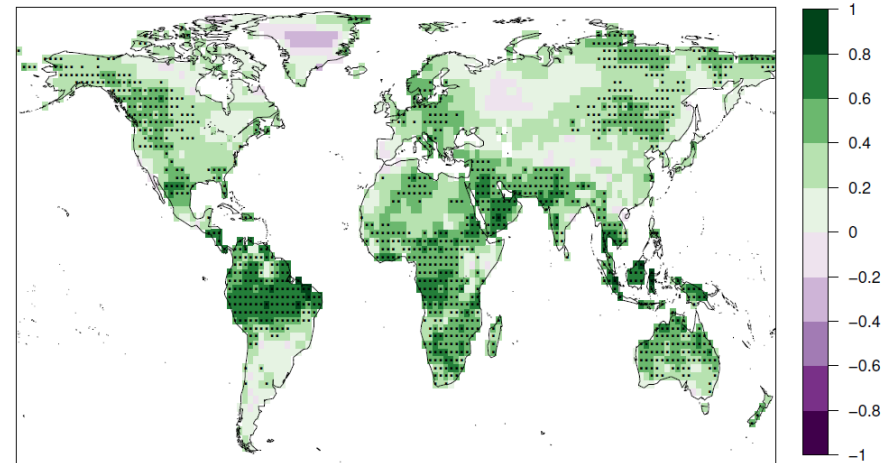
(raw data; points: $p < 0.05$)



Spearman correlation for T2M ECMWF–System4 against ERA–Interim

Start date: February – Lead time: 2 – Period: 1982/2014

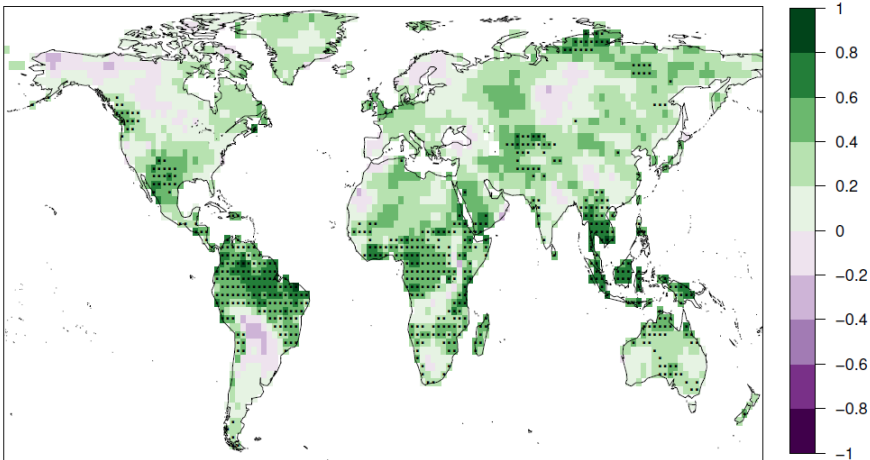
(raw data; points: $p < 0.05$)



Spearman correlation for T2M ECMWF–System4 against ERA–Interim

Start date: February – Lead time: 3 – Period: 1982/2014

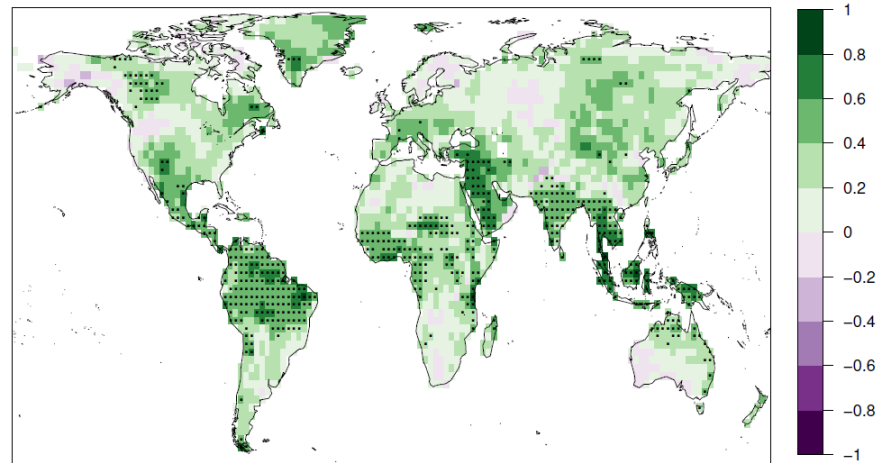
(raw data; points: $p < 0.05$)



Spearman correlation for T2M ECMWF–System4 against ERA–Interim

Start date: February – Lead time: 4 – Period: 1982/2014

(raw data; points: $p < 0.05$)



Evaluation of surface air temperature CFSv2 forecasts over land grids issued in February for 4 lead times from month-1 to month-5. Spearman correlation considering raw data

- Climate predictions have nonetheless some skill in predicting anomalies in the seasonal average of the weather i.e., anomalies of the climate.
- This skill is present regardless of the daily timing of the major weather events within the period.
- This level of skill for seasonal averages or totals may be useful for sectors impacted by climate variability, such as viticulture.
- Now is the time to develop climate services for agriculture based on seasonal forecast predictions. Bridging the gap to ensure that research reaches the industry and society in a timely and usable manner.



**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación



Thank you!

For further information please contact:

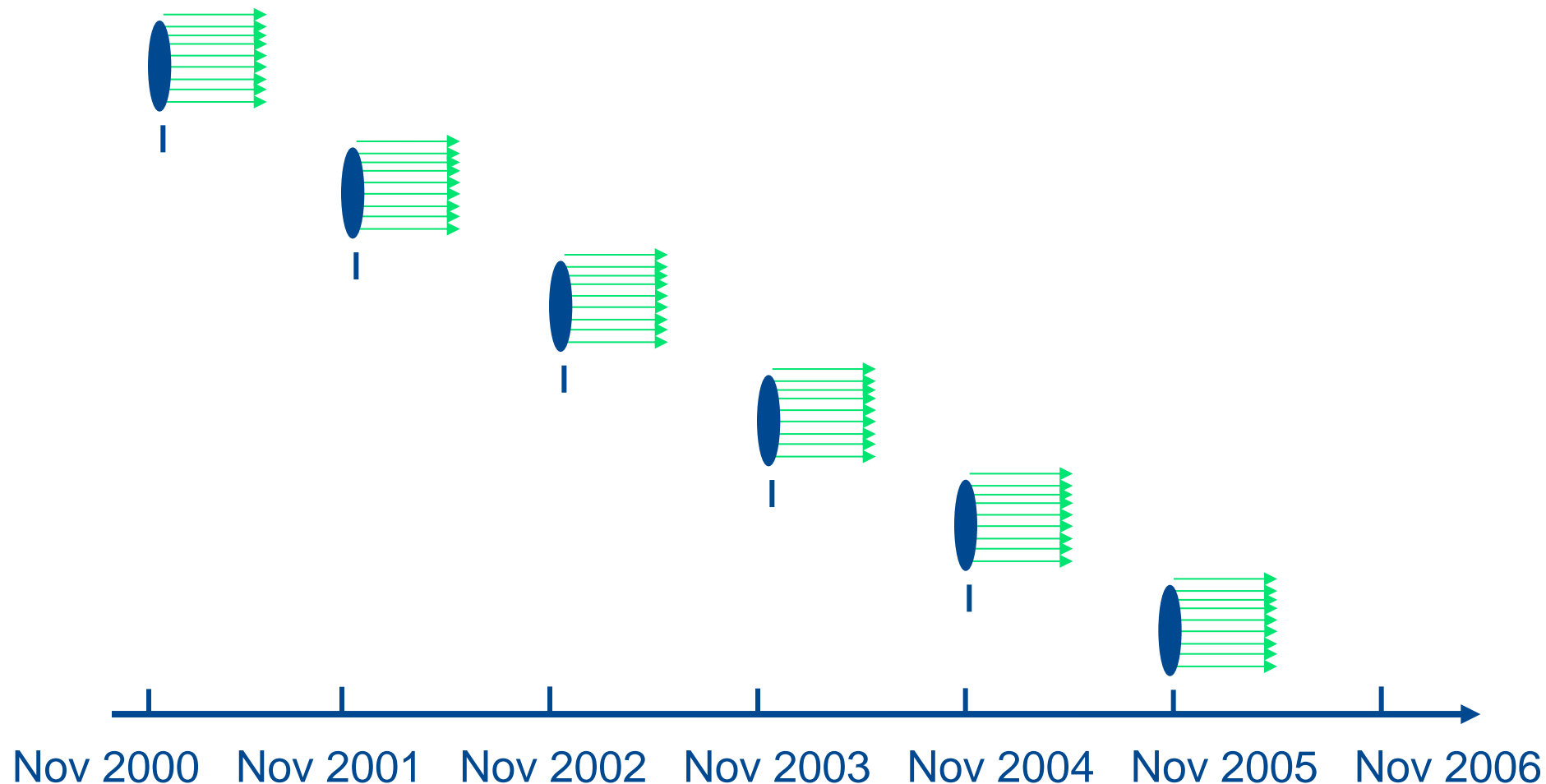
info-services-es@bsc.es

albert.soret@bsc.es

**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



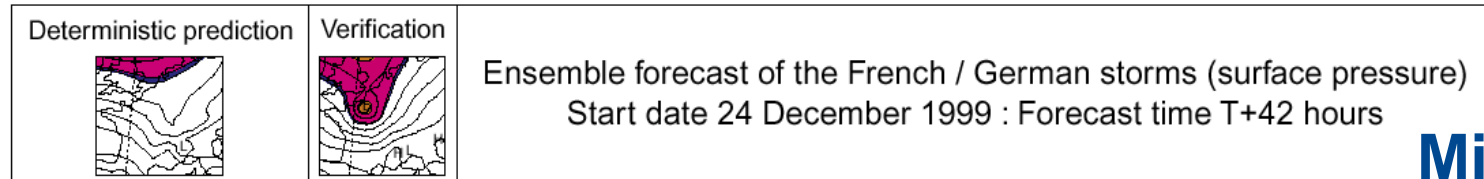
Ensemble forecast system



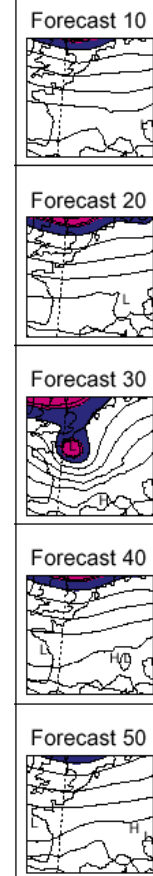
How many members: ensemble size



ECMWF forecasts (D+42) for the storm Lothar



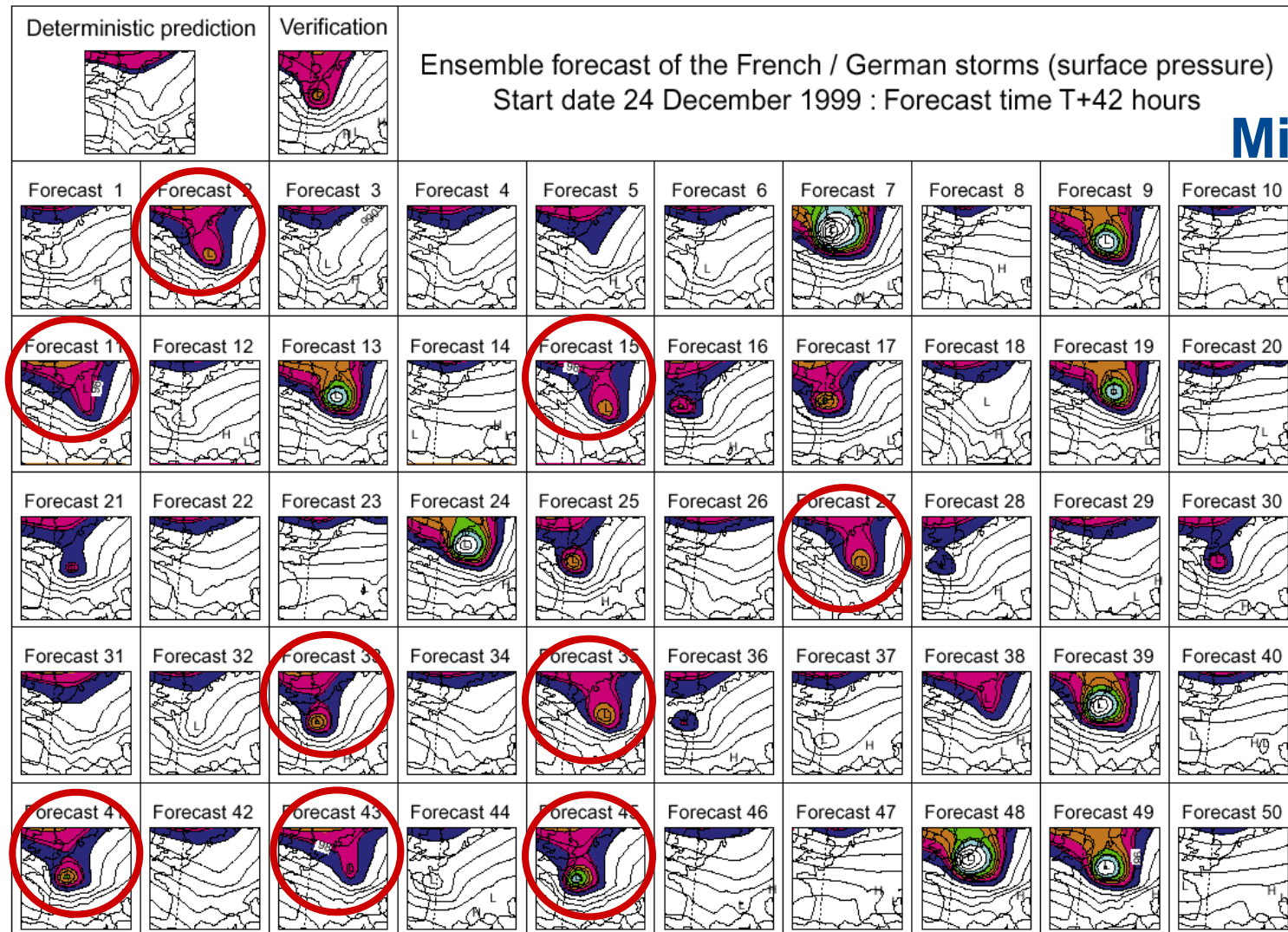
Misses



How many members: ensemble size



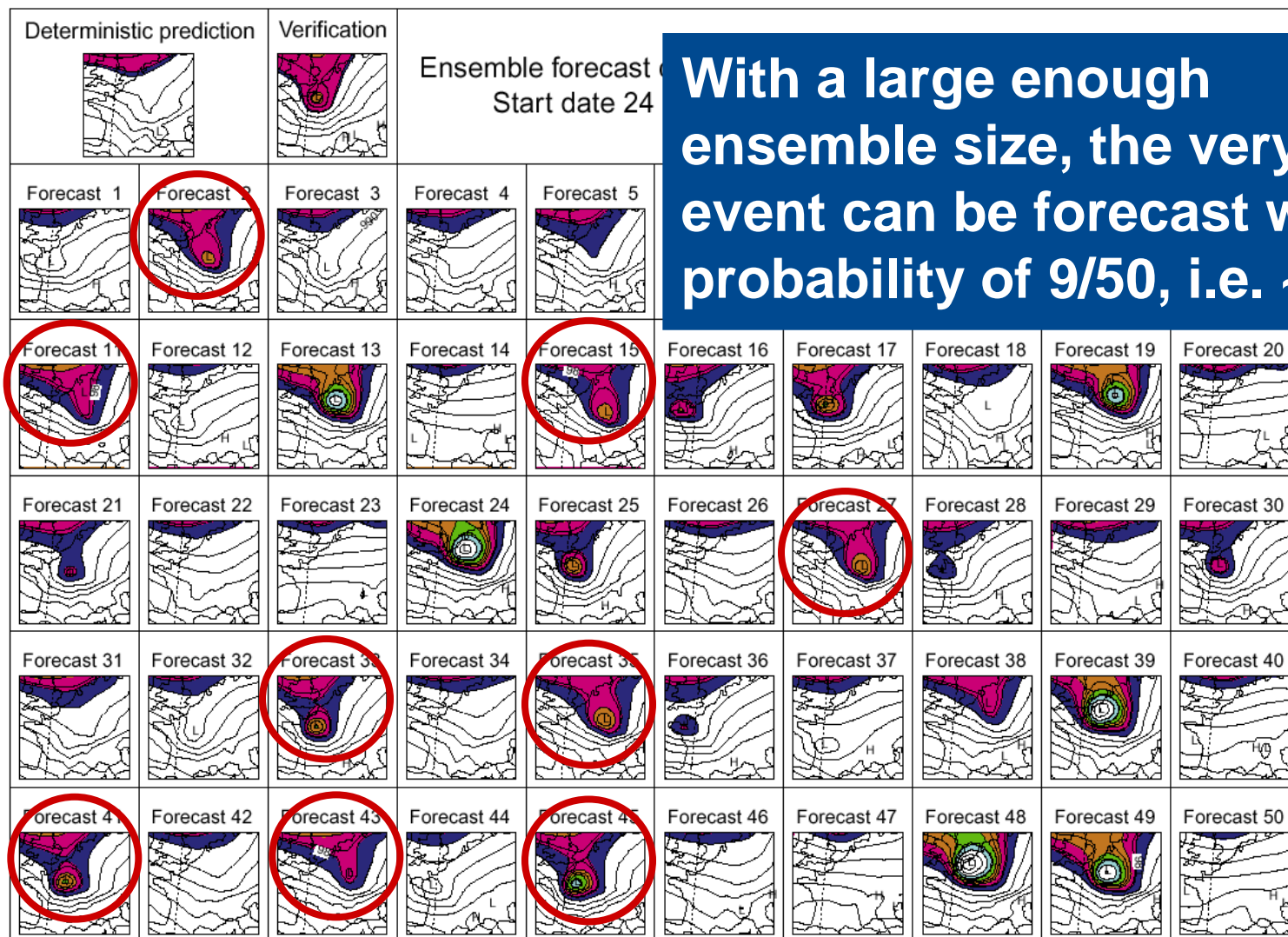
ECMWF forecasts (D+42) for the storm Lothar



How many members: ensemble size

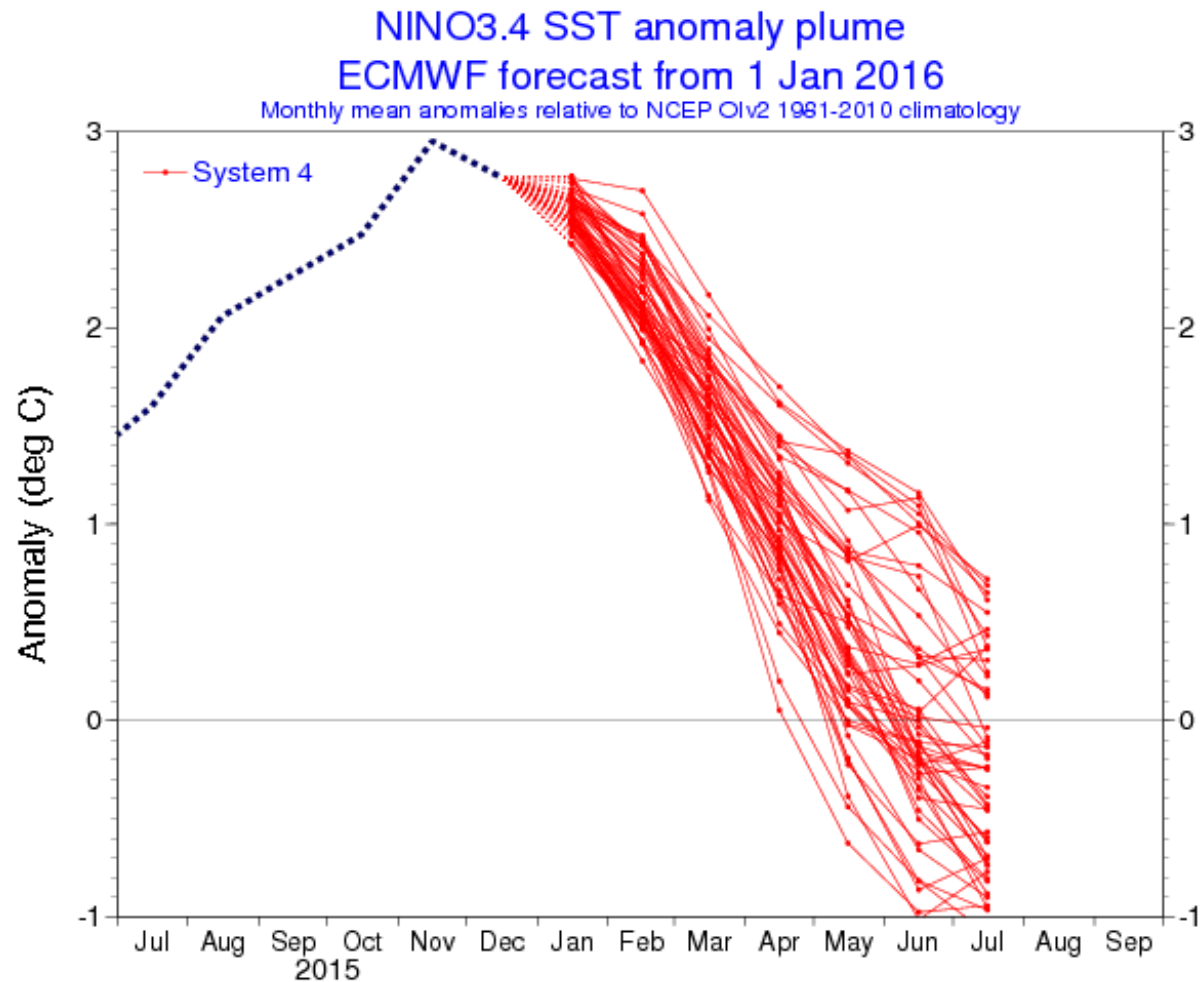
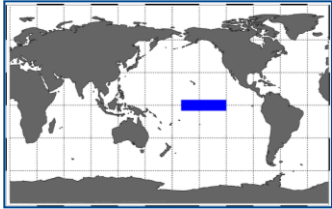


ECMWF forecasts (D+42) for the storm Lothar



With a large enough ensemble size, the very rare event can be forecast with a probability of 9/50, i.e. ~20%

ENSO ensemble predictions



Perfect prognosis approach:

- In the training phase the statistical model is calibrated using observational data for both the predictands and predictors (e.g. reanalysis data)
- Typical techniques: transfer functions, analogs, weather typing, weather generators, etc. (Maraun et al. 2010)

